An emphasis-use approach to conserving biodiversity

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Reserve networks (Noss and Cooperrider 1994) and ecosystem management (Overbay 1992, Salwasser 1992) have evolved as alternative approaches for conservation of biodiversity, although this view is not held by some proponents of large reserve networks (Noss and Cooperrider 1994:213, DellaSala et al. 1995:141-142). The goals described by Noss (1983) for conservation of biodiversity are common to both approaches: (1) maintenance of ecosystem pattern and process within the natural range of variability, i.e., ecosystem integrity; (2) maintenance of viable populations of plant and animal species and their distributions; and (3) maintenance of long-term ecological and evolutionary processes. Both approaches are compatible in relying on the same principles of ecology and conservation biology, but differ in their emphasis on reserves and the levels of acceptability of human impact. Ultimately, we need to abandon divisive rhetoric and find common ground to fashion feasible approaches to meet our common goals (Perry 1995).

Reserve systems, as they have developed in recent years, rely on an extensive network of core areas with little or no human intrusion, surrounded by buffer zones or secondary core areas with limited uses, intervening matrix areas for extractive uses, and corridors linking reserves. The most restrictive approaches to reserve networks (Noss and Cooperrider 1994, DellaSala et al. 1995) are based on several general assumptions: (1) designation of reserves based on umbrella species or ecological "hot spots" (high species richness or endemism) will maintain all affected species; (2) natural processes will produce desired conditions without human intervention, i.e., effects of past management or human use do not affect natural processes; (3) human use or intervention is largely unproductive or deleterious for most species; (4) the scale of ecological processes, particularly disturbance, is limited by the size of the reserves; (5) fragmentation is usually a negative attribute (which ignores inherent fragmentation in dynamic landscapes); and (6) social and economic values are considered constraints rather than integral to achieving sustainable solutions. These assumptions are the basis of a very restrictive network design, but sufficient flexibility can and should be built into network layout and management to allow other designs (Harris 1984, Perry 1995).

Noss and Cooperrider (1994:168) suggest that an average 50%, ± 25%, of an area should be in reserves with as much as 99% of an area reserved in cases where landscapes are heterogeneous or dynamic. A reserve network for the diverse inland Northwest, such as proposed by DellaSala et al. (1995), would likely require >50% of the area in reserves. A reserve plan for the Oregon Coast Range (Noss 1993) would place 50% of the area in reserves with very restricted human activity and another 25% in buffer zones with limited human use. Paradoxically, hard boundaries are required for reserve networks, but proponents claim boundaries are counterproductive to a naturally functional and inter-connected landscape (Noss and Cooperrider 1994:92, 95). This may be the "open door" for reconciliation with ecosystem management, which focuses on whole landscapes rather than administratively fragmenting the landscape into separate land-use allocations.

Ecosystem management of landscapes is accomplished using a combination of custodial management (i.e., reserves with various levels of use—wilderness, late successional forest reserves, research natural areas) and active management to maintain or restore ecosystem integrity and meet the needs of society when and where they are consistent with

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ecosystem integrity (Bourgeron and Jensen 1994, Jensen and Everett 1994, Bourgeron et al. 1995). Ecosystem management may be more flexible than the strategy of reserve networks in recognizing that management must work within a hierarchy of ecological scales and public interests. The effects of past and current human use are recognized implicitly as affecting the trajectory of ecological change. Human intervention can be perceived positively, as having potential value in achieving desired ecosystem characteristics. Achieving multiple social values is considered integral, rather than constraining, to success in conserving biodiversity. Various types of reserves and corridors may be used in ecosystem management to maintain or restore important features of a system, but the emphasis is on integration of all values across the landscape where appropriate and consistent with ecosystem pattern and process. An array of land allocations, representing multiple social expectations, guided past management and will likely be a part of future plans. Many current reserves, and other land allocations, are essentially "emphasis-use" areas for fine-filter management of species, specific habitats, or commodity use.

Emphasis-use approach

The "emphasis-use" approach to land management protects the emphasized use of individual land allocations and merges adjacent land allocations into larger, integrated landscapes. The emphasis-use concept was first developed to integrate management of rare plant species with the management of larger landscapes, but can be extrapolated readily to other species and settings (Everett et al. 1994, Everett et al. 1995). The emphasis-use approach contributes to the conservation of biodiversity by expanding biodiversity goals beyond the scope of reserve allocations, by increasing reserve sustainability through the re-establishment of inherent disturbance regimes in existing reserve allocations, by reducing administrative fragmentation of forest landscapes, and by using disturbance management to conserve biodiversity while providing commodities to meet public expectations. As such, the emphasis-use approach bridges the gap between reserve networks and ecosystem management.

The public has expressed its expectations for resource conditions and commodity production in land-use allocations and associated vegetation characteristics that achieve the emphasized use, e.g., reserves or matrix areas for commodity production in the President's Northwest Forest Plan (U.S. Dep. Agric. 1993). The strength of the emphasis-use approach lies in its ability to realistically and ecologically manage various types of land allocations and its potential to integrate diverse allocations to achieve larger landscape biodiversity goals. This approach does not initially require additional land-use allocations for reserves and can be implemented immediately within current land allocations.

Protect emphasized use through disturbance management

Preservation does not mean holding nature static, but "perpetuating the dynamic processes of presettlement landscapes" (Noss 1983:703). To protect biodiversity, inherent disturbances both internal and external to reserve allocations should be restored and managed to reduce deleterious effects to the intent of the reserve. Inherent disturbance regimes are those which, by frequency, severity and extent of disturbances, created and maintained pre-eurosettlement flora and fauna. A non-inclusive list of major disturbances are: wind throw, fire, insect, disease, flooding and mass wasting (Urban et al. 1987).

Hierarchical disturbance regimes create and maintain a mosaic of vegetation patterns on the landscape (Urban et al. 1987, White 1987). Some disturbance events are restricted to a portion of a reserve, while others occur at the same or a larger scale (Fig. 1). Reestablishing inherent disturbance regime effects and continuity in disturbance events among allocations should improve long-term sustainability of reserves and adjacent land allocations while providing opportunities to meet other public expectations for forest resources.

For example, to conserve the limited and patchy (<1.0 ha) habitat of Wenatchee Larkspur (*Delphinium veridescens*, federal candidate species) in the Camas Meadows of eastern Washington we

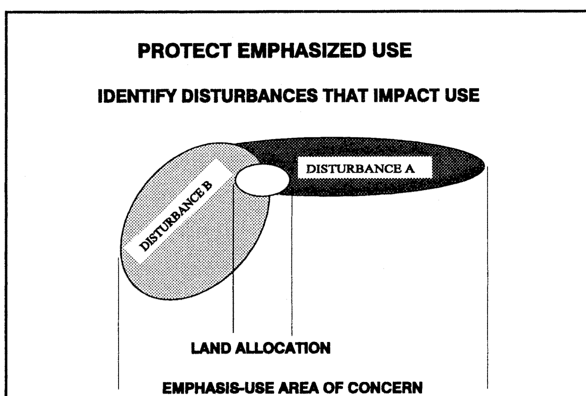

Fig. 1. Area required to manage for disturbance effects can exceed the area of the land allocation.

should consider potential disturbances of different types and extent. Within-patch disturbance is required to prevent canopy closure and loss of habitat, but disturbance needs to be moderate to maintain canopy shading at 33–66% for maximum *Delphinium* vigor (R. Everett, Wenatchee For. Sci. Lab, Wenatchee, Wash., 1993, unpubl. data). Disturbances that significantly change levels of canopy cover in this watershed could alter hydrologic processes and adversely impact *Delphinium* habitat (currently restricted to moist soils adjacent to streams, seeps and shallow drainage bottoms). At a larger scale, there is an expanding elk herd using several watersheds. This herd grazes and tramples the *Delphinium* habitat and needs to be controlled. Although the area of the reserve is small, the area that should be managed with concern for the emphasis use within the reserve is much larger (Fig. 1). Managing for required disturbances to reduce crown cover and elk numbers provides both the conservation of biodiversity, in this case the preservation of a rare plant, as well as commodity outputs in terms of timber and recreation. A goal of the emphasized-use approach is the development of this kind of synergistic relationships.

Reduce administrative fragmentation and increase pattern continuity

Land-use allocations can administratively fragment the forest if each allocation requires different stand and landscape characteristics to achieve the emphasized use (Fig. 2*a,b*). For example, species composition and structure in stands and landscapes managed for timber production in the general matrix forest are different than landscapes managed for deer winter range (40% cover, 60% forage; Thomas 1979), and both may be significantly different from historical conditions that were in synchrony with inherent disturbance regimes for the site.

Recent set-asides for individual species or unique habitats (e.g., spotted owl, late-successional reserves, riparian buffer zones) have further increased administrative fragmentation of the landscape. Levels of species abundances, habitats, and products that once could be derived from an entire area now must be derived from individual land allocations. Maximization of emphasized use in each land allocation can limit the contributions of the allocation to achieve larger landscape goals. Rather than continue the process of dividing up the land area into finer and finer segments, we need to reverse this process and find a way to integrate the current array of land allocations to achieve larger landscape expectations. The emphasis-use approach uses existing land-use allocations, but modifies stand and landscape structure to

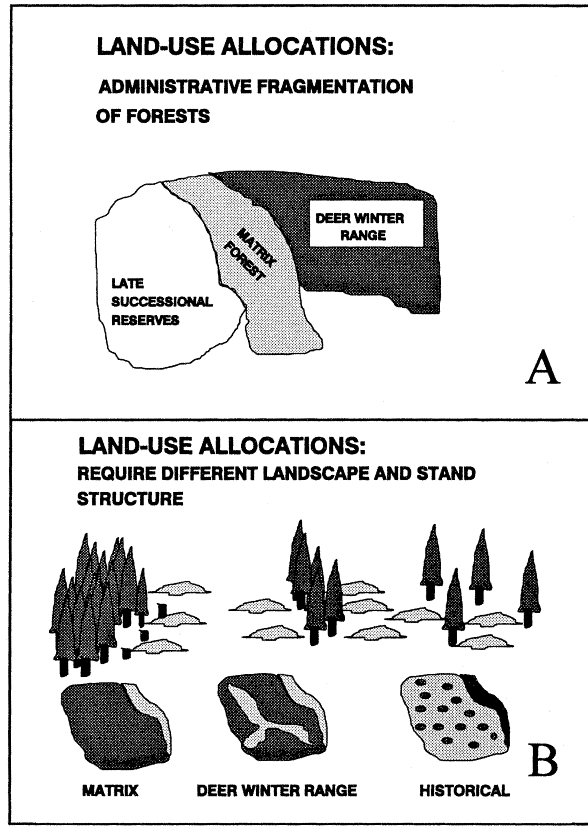

Fig. 2. Administrative fragmentation of landscapes by land-use allocations and associated stand and landscape characteristics.

integrate them with adjacent land allocations (Fig. 3). Adjacent land-use allocations are integrated by reciprocal conservation of characteristics of emphasized vegetation and by re-establishment of shared disturbance effects.

Enhance biodiversity goals

Extending biodiversity considerations from reserves to adjacent land allocations should enhance the conservation of biodiversity and better integrate reserves with adjacent lands. The area required to conserve biodiversity in the United States exceeds the amount of pristine land available or that which would likely be dedicated to biodiversity in light of competing interests (Hansen et al. 1991). Given the small portion of land allocations dedicated to conserving biodiversity, we should capitalize on opportunities for expanding biodiversity objectives to adjacent allocations. Areas that support desired biodiversity habitat in reserves also should be conserved in similar landscape areas in adjacent lands (Fig. 4). This process would reduce abrupt vegetation pattern changes at the edges of reserves and thereby increase

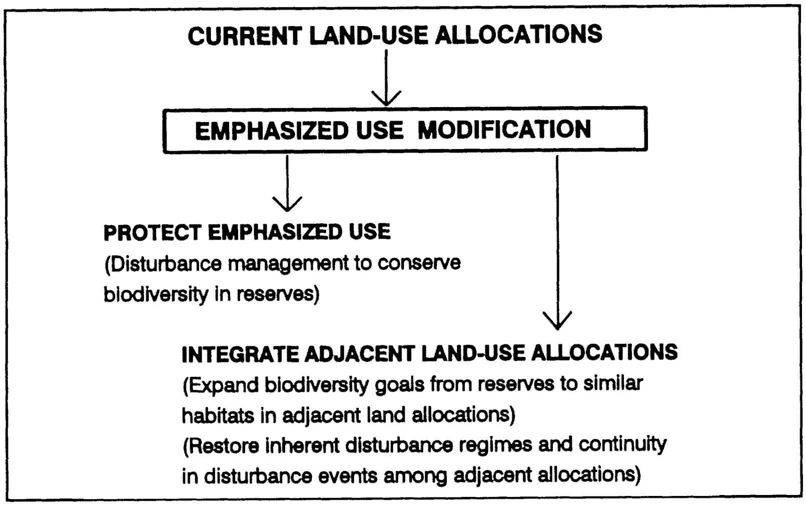

Fig. 3. Emphasis-use approach to conserving biodiversity and integrating existing land-use allocations.

the integration of reserves with other allocations. This process of "feathering the edges" was previously suggested by Franklin and Forman (1987) for individual stands.

Late Successional Reserves established by the President's Northwest Forest Plan (U.S. Dep. Agric. 1993) in dry pine and fir forests on the east slope of the Cascades are an example of reserves that would benefit from the process of feathering land allocation edges. Here old forest stands occur as small patches in specific topographic positions in a matrix of other forest types (Camp 1995). Because old-forest stands are small (7-12% of the land surface) the conservation of old-forest habitat in adjacent land allocations would significantly increase amounts of old forest conserved, while leaving the remaining 88-93% of the land allocation dedicated to its primary emphasized use. By conserving habitat in adjacent allocations, continuity in forest structure, composition, and pattern would be improved across larger landscapes. The conservation of habitat in adjacent land allocations to meet biodiversity goals could be offset with reserve outputs or conditions that contribute to the emphasized use of the adjacent allocation.

Increase disturbance continuity

Integration of reserves and adjacent land allocations involves reestablishing common disturbance effects across boundaries or within each allocation. In some instances, disturbance regimes would impact several land allocations. In other instances, disturbances would not cross land allocation boundaries, but would occur with similar frequency, severity, and extent within each allocation. Re-establishment of internal and external disturbance effects in reserves is consistent with reserve designs that call for a "minimum dynamic area" containing the dominant disturbance regimes (Pickett and Thompson 1978). In the emphasis-use approach, rather than enlarging the reserve to encompass all inherent disturbance regimes, the adjacent land allocations are used to meet large-scale disturbance requirements.

In our Late Successional Reserve (LSR) example continuity in disturbance regimes is accomplished in the re-establishment of high frequency-low severity fire regimes on south slopes in both the LSR and adjacent allocations. Fire disturbance does not necessarily cross allocation boundaries; rather, periodic ground fires maintain low crown-fire hazard in each allocation so that neither constitutes a fire hazard.

In our *Delphinium* habitat example, continuity in disturbance is found in insects, diseases or fires that affect canopy cover and hydrologic processes in the patch habitat and at the watershed level. Loss of individual or groups of trees in the patch prevents crown closure and maintains *Delphinium* habitat in seeps and other moist sites.

Inherent disturbance regimes

Conserving biodiversity is directly related to conserving the dynamic functions of the ecosystem (Noss 1983, Hansen et al. 1991). Whole biotas have evolved as a result of dominant disturbance factors such as fire and some terrestrial and aquatic systems require a disturbance "pulse" to maintain ecosystem function (Odum 1969). Re-establishment of dominant inherent disturbance regime effects should enhance the long-term stability of ecosystems and the maintenance of biodiversity (Noss 1983, Urban et al. 1987, Sampson 1992). Inherent disturbances create a shifting mosaic steady-state of vegetation patches, maintain structural stand complexity, and promote plant and animal diversity (White 1987, Hansen et al. 1991, Sampson 1992).

For continued stability of reserve allocations, vegetation composition and structure at the stand and landscape level should be supportable under the inherent disturbance regimes for the area. Re-establishing inherent disturbance regimes in ecosystems characterized by a dynamic equilibrium in shifting mosaic vegetation would require mimicking the frequency, severity and extent of the dominant disturbance agents. This would be no small task under current environmental and public constraints, but land managers have demonstrated a significant capability to restructure large landscapes. In non-equilibrium ecosystems, severe disturbance events impact large landscape areas causing the loss of the habitat [reserve] for tens of decades and dynamic equilibrium (if possible) must be thought of in much larger time and spatial scales (Sprugel 1991). Because large-scale losses of reserves for extended periods of time do not meet public expectations and because reestablishing large-scale disturbance regimes may no longer be possible with altered landscapes, the re-establishment of large-scale disturbance events may have to be created through the cumulative treatment of smaller areas.

The greater the disparity between inherent and current disturbance regimes and associated vegetation characteristics, the greater the potential for a loss in reserve habitat through fire, insect or disease vectors. In the Western United States the potential for catastrophic disturbance is increasing in overstocked, dry pine forest types (Covington et al. 1994) and poses a hazard to biodiversity. For example, the ponderosa pine-Douglas fir forest type of the Entiat watershed in Eastern Washington has an inherent high frequency/low severity fire regime (Agee 1995). The fire-free interval was 6–9 years before eurosettlement, but a significant fire had not occurred for the last 100 years (Everett 1995). What had once been open pine stands became dense fir forest, and by 1994 the fire regime had been significantly altered such that much of the 140,000-acre Tyee fire in the Entiat watershed burned with moderate to high severity (Agee 1995). Four Late Successional Reserves established by the President's Northwest Forest Plan (U.S. Dep. Agric. 1993) located in this burn were severely damaged.

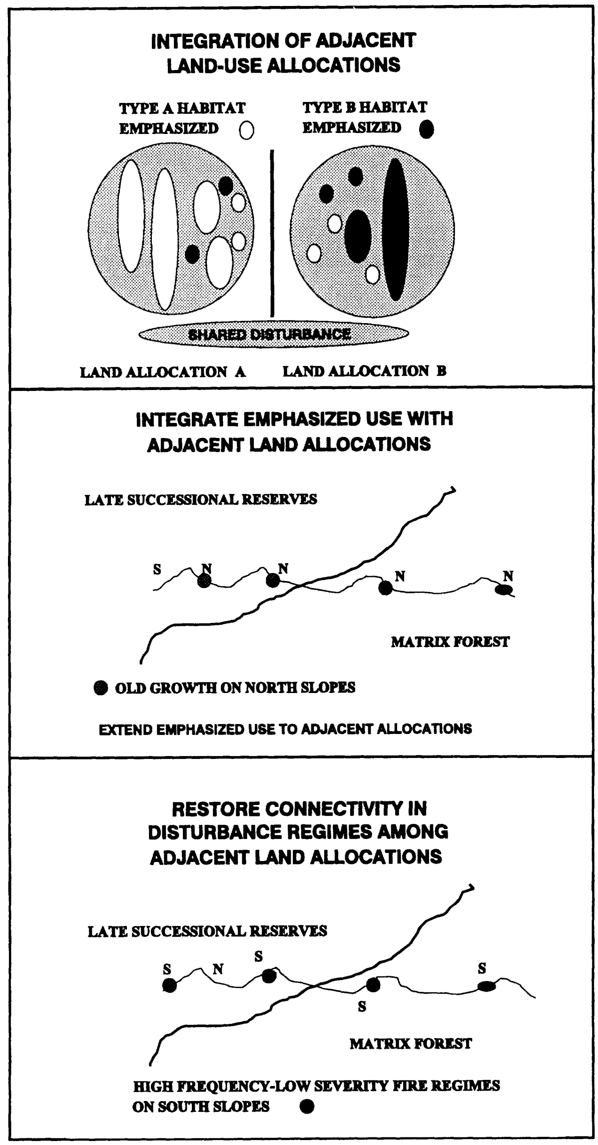

Fig. 4. Integration of adjacent land allocations.

In adjacent unburned forest areas the conflict between "ecosystem-community" management (re-establishment of inherent disturbances) for ecosystem stability has come in conflict with "species management" (White and Bratton 1980) in the conservation of spotted owl habitat. Land managers face conserving spotted owl habitat where it was not present before eurosettlement or altering current habitat conditions to conserve the larger landscape. Stand and landscape structure and composition in some spotted owl neighborhoods are not in synchrony with inherent disturbance regimes for the area, and there is increased potential for a catastrophic fire event. Old forest characteristics such as dense, closed, multi-layered-canopy stands with abundant snags and logs that are often cited as part of spotted owl habitat are not readily sustainable under a high frequency/low severity fire regime (Agee and Edmonds 1992). Given the close relationship of species and their habitat to inherent disturbance regimes the best long-term approach to maintaining biodiversity, and specifically owl habitat, may prove to be maintaining the integrity of ecosystem function (Agee and Edmonds 1992, Walker 1992).

Adjusting land allocation boundaries

The emphasis-use approach utilizes existing land allocation boundaries for defining areas with specific emphasized uses and the required vegetation characteristics to support those uses. In the long term, the description of and management for inherent disturbance effects will ultimately define the vegetation characteristics sustainable over time without major management inputs. Land-use allocation boundaries should be adjusted over time as inherent disturbance effects define the location and sustainability of vegetation attributes associated with a specific use. Integrated management of the whole landscape, rather than individual allocations, may be possible and could contribute to the conservation of biodiversity at larger scales. Because re-establishment of inherent disturbances is management working with, rather than against natural processes, we should expect increased sustainability of ecosystems and emphasized uses. As connectivity in disturbance regimes and shared habitats among land allocations becomes evident, reserve boundaries should soften. If wide spread ecological stability were to occur, the need to maintain discrete biodiversity reserves would decline (Frissell and Bayles 1996).

Emphasis-use concept application

The success of the emphasis-use approach lies in its design and application. The concept fails when the initial land allocation is in error; when the allocation and the emphasized use are not in synchrony with the inherent disturbance regimes of the area. As an example, if Late Successional Reserves are established in areas with a high-frequency-low-severity fire regime we should not expect to be successful in creating and maintaining old forest structure and composition that would occur only in a low frequency/high severity fire regime. The reevaluation of land allocation and emphasized use sustainability should be a priority for all land allocations and specifically for biodiversity reserves. If reserves have been created that are not sustainable over time, new reserve areas should be found or created to safeguard biodiversity over the long term.

The reevaluation of reserves areas and their modification was an integral part of the President's Northwest Forest Plan (U.S. Dep. Agric. 1993) east of the Cascades and also of the PACFISH (U.S. Dep. Agric. 1994) buffer zones for riparian areas. In both instances, the creators of these documents realized the dynamic nature of inland forests and recommended the reevaluation of initial set-asides as more scientific information became available. New information on inherent disturbance regimes and vegetation characteristics that are in synchrony with the accompanying disturbance effects will improve the land manager's ability to evaluate the need, characteristics, and sustainability of reserve or buffer areas over time.

Adaptive management approach

Ecosystem management concepts including emphasis-use should be viewed as tentative and experimental in nature until proven in numerous situations and over extended time frames. The adaptive management process provides a method to evaluate active management concepts [emphasis use] as an experimental landscape treatment even in uncertain environments (Holling 1978, Walters and Holling 1990). Caution is needed due to inadequate knowledge and flexibility is required because of unplanned disturbance events (Frissell and Bayles 1996). Where risk of management error and risk of biodiversity loss is high with an active management-emphasis use approach, caution is indicated (Marcot 1986) and a custodial management approach may be a more prudent alternative. Conversely, on reserve areas where the disparity between current vegetation conditions and those supportable under the inherent disturbance regime is high and increasing, the hazard to biodiversity may be greater under custodial management.

Management implications

Reserve networks and ecosystem management have been described as competing approaches for managing natural systems for the conservation of biodiversity and for providing social and economic benefits. However, both approaches have common goals and rely on the same principles. Differences occur in the emphasis on reserve areas and the impact and desirability of human use. The emphasis-use approach allows for immediate integration of both approaches in a flexible design.

The emphasis-use approach contributes to the conservation of biodiversity by protecting an emphasized use in reserves through disturbance management, by identifying and expanding biodiversity goals in all land-use designations, and by the conservation of disturbance and recovery processes that enhance the long-term sustainability of reserves and the larger landscapes in which they exist. Historically, the U.S. Forest Service has partitioned the public lands it administers into separate land allocations to meet specific public expectations. As long as land was abundant and demands for use of the land were few, the allocation process worked, but as public needs and expectations for the land grew, the opportunities for additional allocations declined. The allocation process still may do well in meeting public expectations for a specific allocation, but it does poorly at meeting public expectations for larger landscapes, including the conservation of biodiversity and commodity outputs.

The failure of the land-allocation processes to adequately conserve biodiversity has resulted in a series of scientific investigations and broad land-management directives for the conservation of the spotted owl, old growth species, and late successional reserves. These directives further partition public lands and reduce the land base available for commodity production. The land-allocation process that administratively fragments the landscape needs to be reversed. Land allocations should be integrated into larger landscapes to achieve large-scale biodiversity goals. Meeting most public expectations for the land will require that the land be managed holistically; emphasized use of each allocation is protected, but other complementary uses are encouraged, especially uses that contribute to large-scale biodiversity objectives. Biodiversity is conserved and land allocations are integrated by expansion of desired habitat goals in reserves to specific landscape positions in adjacent land allocations (continuity in pattern). Also, land allocations are integrated by the re-establishment of inherent disturbance regime effects at multiple scales, including disturbance events larger than the individual land allocation (continuity in disturbance).

Current land allocations, including reserves, should be evaluated for sustainability under inherent disturbance regimes. Adjustments should be made where reserve or buffer-area vegetation structure and pattern are not in synchrony with inherent disturbance regimes. The re-establishment of inherent disturbance regime effects will define the probable vegetation composition, structure, and pattern that is sustainable over time. An array of stand and landscape characteristics may be supportable under inherent disturbance regimes, and management in response to public expectations may result in conditions that differ from historical landscapes.

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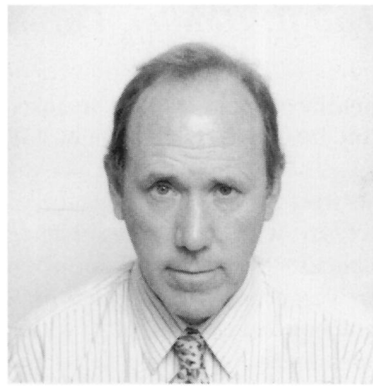

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